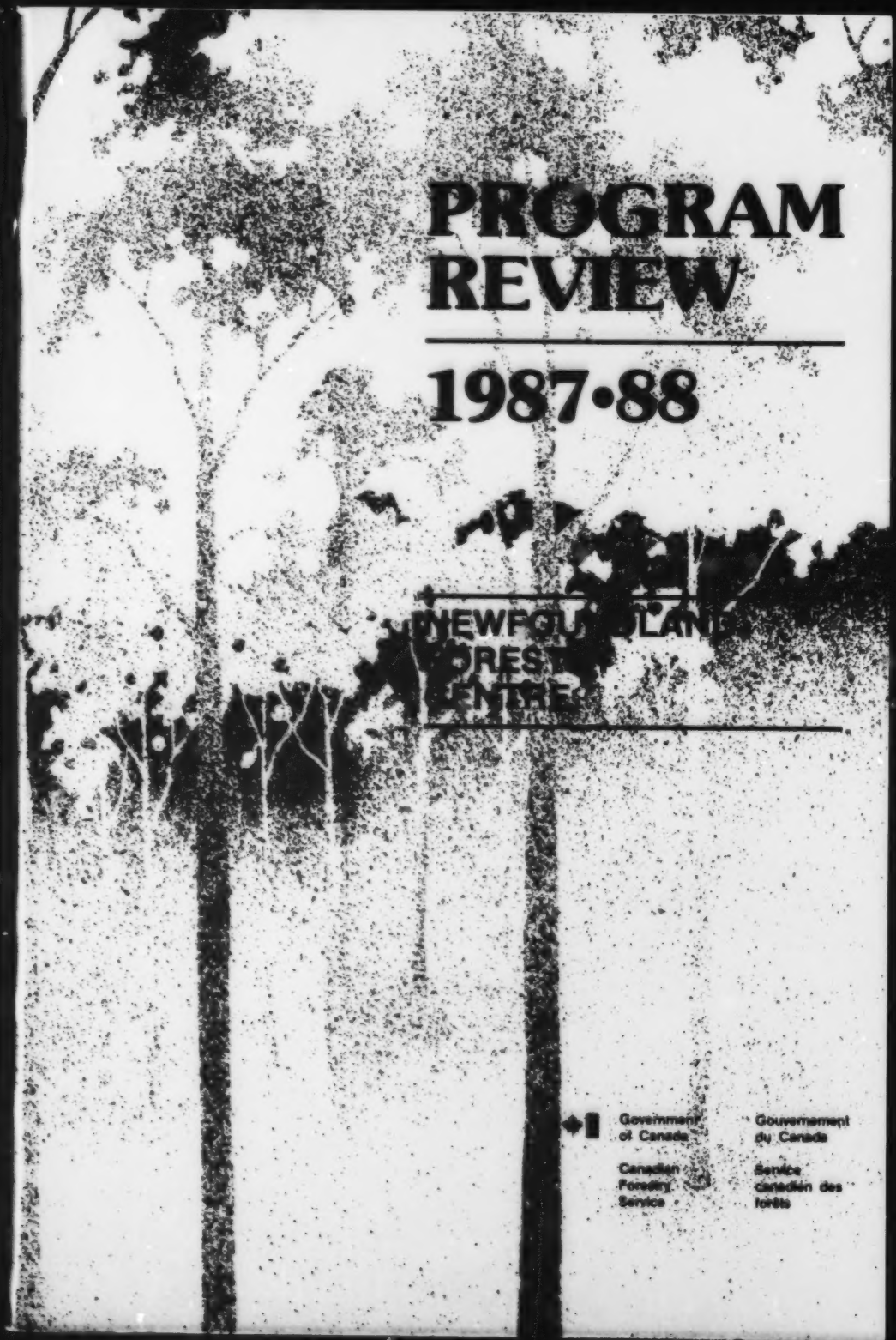
PROGRAM
REVIEW
1987•88
NEWFOU LAND
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ENTRE
Government of Canada
Canadian Forestry Service
Gouvernement du Canada
Service canadien des forêts

89-03429/

PROGRAM REVIEW
1987-88

NEWFOUNDLAND FORESTRY CENTRE
CANADIAN FORESTRY SERVICE
GOVERNMENT OF CANADA

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The Canadian Forestry Service Government of Canada

The Canadian Forestry Service is the main focus for forestry matters in the federal government. It provides national leadership through the development, coordination, and implementation of federal policies and programs to enhance long-term economic, social, and environmental benefits to Canadians from the forest sector.

The service is a decentralized organization with six regional forestry centres, two national research institutes and seven regional sub-offices located across Canada. Headquarters is located in the national capital region, in Hull, Quebec.

In support of its mandate, the Canadian Forestry Service carries out the following activities:

- Administers forest development agreements negotiated with the provinces.
- Undertakes and supports research, development, and technology transfer in forest management and utilization.
- Compiles, analyzes, and disseminates information about national and international forest resources and related matters.
- Monitors disease and insect pests in Canada's forests.
- Provides information, analyses, and policy advice on economics, industry, markets, and trade related to the forest sector.
- Promotes employment, education, and training opportunities in the forest sector.
- Promotes public awareness of all aspects of the forest sector.

The service interacts regularly with provincial and territorial governments, industry, labour, universities, conservationists, and the public through such bodies as the Canadian Council of Forest Ministers, the Forest Sector Advisory Council, the Forestry Research Advisory Council of Canada, the Canadian Forest Inventory Committee, the Canadian Committee on Forest Fire Management, the Canadian Interagency Forest Fire Centre, and regional consultative committees. The service is also active in international forestry agencies such as the International Union of Forest Research Organizations and the Food and Agriculture Organization, as well as in technical and trade missions.

Le Service Canadien des Forêts Gouvernement du Canada

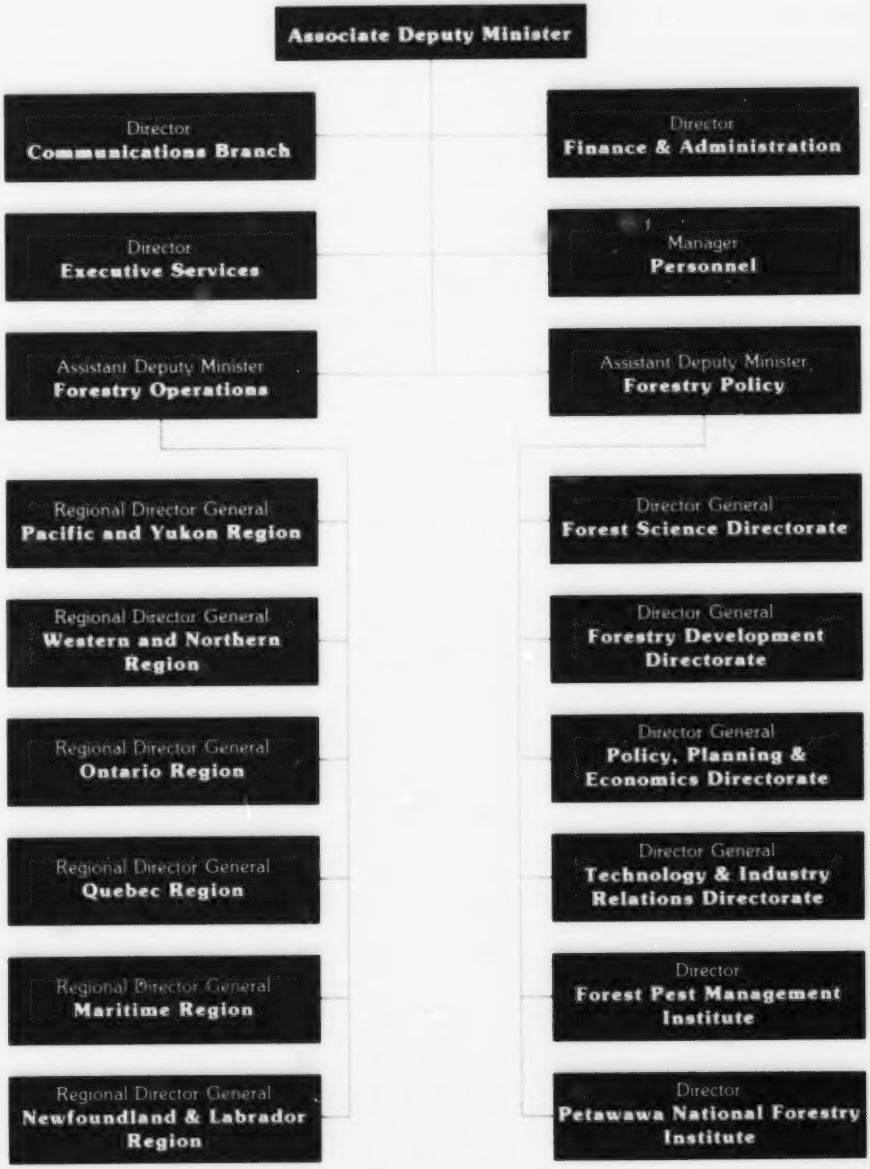
Le Service canadien des forêts est l'organisme principal en maatière de foresterie à l'intérieur du gouvernement féderal. Chef de file sur le plan national, il assure la preparation, la coordination et la mise en oeuvre ces politiques et programmes fédraux dans le but d'améliorer les avantages économiques. Sociaux et environnementaux a long terme offerts aux Canadiens par le secteur forestier.

Le Service est une organisation décentralisée: six centres de foresterie régionaux, deux instituts de recherche nationaux ainsi que sept sous-bureaux régionaux sont répartis dans tout el Canada. Le siège social est établi dans la région de la Capitale nationale, à Hull (Québec).

Pour remplir son mandat, le Service canadien des forêts assume les tâches suivantes:

- il administre les accords de développement forestier conclus avec les provinces
- il entreprend et appuie la recherche, la mise au point et le transfert technologique dans le domaine de la gestion et de l'utilisation des forêts
- il rassemble, analyse et diffuse de l'information sur les ressources forestières nationales et internationales et les domaines connexes
- il fait des relevés des maladies et des insectes ravageurs des forêts canadiennes
- il fournit de l'information, des analyses et des conseils (quant aux politiques) concernant l'économie, l'industrie, les marchés et le commerce reliès au secteur forestier
- il favorise les occasions d'emploi et de formation universitaire et technique dans le secteur forestier
- il encourage les Canadiens à prendre conscience de tous les aspects du secteur forestier

Le Service entretient des rapports sur une base regulière avec les gouvernements provinciaux et territoriaux, l'industrie, le monde du travail, les universités, les environnementalistes et le public par l'entremise d'organismes comme le Conseil canadien des ministres des Forêts, le Conseil consultatif du secteur forestier, le Conseil consultatif de la recherche forestière du Canada, le Comité de l'inventaire des forêts du Canada, le Comité canadien de la gestion des incendies de forêt, le Centre interservices des feux de forêt, le Centre interservices des feux de forêt du Canada et des comités consultatifs régionaux. Le Service joue également un rôle actif dans des organismes internationaux de foresterie comme l'Union internationale des organisations de recherche forestière et l'Organisation pour l'alimentation et l'agriculture, de même qu'au sein de délégations de nature technique ou commerciale.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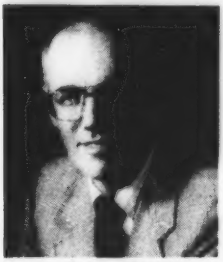


J. A. Munro

Newfoundland Forestry Centre

Foreword

A predicted shortfall of economically accessible timber for some areas of this region has prompted the major forestry agencies to substantially increase forest improvement activities in recent years. This has stimulated research and development, especially in the areas of forest renewal and forest protection. The research programs at the Newfoundland Forestry Centre this year have been highlighted by studies pertaining to stand establishment, growth and yield, ecology and environment, economics, and insect pest control.

Significant areas of forest land on the island of Newfoundland are understocked and subject to severe competition. One source of competition is *Kalmia angustifolia*, a weed species which greatly reduces natural regeneration. Our research efforts to develop silvicultural prescriptions for reforesting sites dominated by *Kalmia* were strengthened through a contract research project this past year.

To support the Provincial Forest Inventory Program, we participated in a cooperative project to test a number of growth and yield submodels for inclusion in a wood supply model for Newfoundland.

For many years our research staff have been accumulating data in the areas of soil and site research. This work will now be summarized in an interpretation handbook to be published in 1989. The handbook is designed to assist field foresters in making decisions regarding silvicultural treatment of disturbed sites. Also in the area of forestry-wildlife interactions, we began a study to assess the impacts of moose browsing on precommercially thinned stands. Early indications are that the foliage of trees in thinned areas may receive greater browsing pressure.

The Forest Protection Research Program emphasized studies pertaining to the hemlock looper. This involved research on population dynamics, damage assessment and a continued effort to test the effectiveness of new insecticide formulations as control measures. Our research effort on spruce budworm concentrated on analysis of data on the impact of the infestation of the 1970s and '80s.

Our Forest Insect and Disease Survey (FIDS) continued to monitor forest insect and disease conditions and reported a rise in balsam woolly aphid populations in western Newfoundland. This led to renewed interest in this pest, and field experiments were undertaken to improve sampling systems and to assess the effect of aphid on the growth of young thinned balsam fir stands.

Research into biological control of forest pests was also enhanced during 1987-88. This work concentrated primarily on monitoring the effect of introduced agents such as the ichneumonid wasp used to control the mountain-ash sawfly and the virus "Virtuss" which was applied against the white-marked tussock moth in western Newfoundland.

Economics research encompassed resource and industrial considerations. Progress in the biomass energy sector was studied as well as alternative methods of valuing commercial forest. A study of the Newfoundland logging industry resulted in a model being developed to assess the economic effects of the forest industry.

The Forest Development Program was dominated by activities in support of the Canada-Newfoundland Forest Resource Development Agreement (FRDA). Approximately $13.5 million was spent, mainly in the areas of forest improvement and access. This year was the second in the four year $48 million agreement signed in 1986. Our Forestry Development staff continued to play an active role in the introduction and adaptation of new technology, particularly in the areas of site preparation, equipment trials and biomass harvesting.

These highlights of our research and development programs are typical of our overall production during 1987-88. The various sections of this Program Review booklet provide you with more detailed information. If any aspect of our operation is of particular interest to you, please contact us and we would be happy to provide additional information.

J.A. Munro
Regional Director General

Program Management

Program Management

Project 1111
Program Management
Project Leader: J. A. Munro

Objectives

To ensure efficient planning and management of the research and development activities of NeFC; to ensure effective use of financial and personnel resources to achieve stated goals and objectives; to ensure that NeFC programs are responsive to the regional needs of client agencies and the national concerns of the Government of Canada.

Achievements Current Year

In 1987-88 overall direction was provided for programs in research and technical services and in forestry development. Staff training needs were identified and appropriate courses provided to the extent of available resources. Work was initiated on the development of an improved planning system for the Centre. Audits of operations, and financial and administrative systems as well as the Forest Resource Development Agreement were completed.

Goals for 1988-89

Continue to provide overall direction and control for CFS operations in the region. Continue to improve the quality of human resources management by appropriate staff training and development courses. Complete the current planning study and have a new planning system in place by the end of the fiscal year.

Finance and
Administration

Finance and Administration

Project 1211/1221
Financial and Administrative Services
Project Leader: R. J. Angel

Objectives

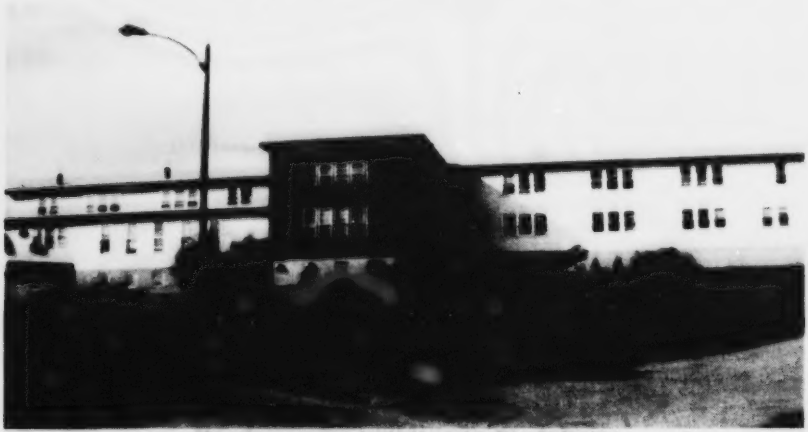
To provide financial, consulting and advisory services to NeFC management; to ensure adequate internal control of finances, provide a complete range of accounting services and maintain adequate accounting records; to administer the financial controls on federal-provincial development agreements and various job creation programs.

Achievements Current Year

As in previous years a wide range of financial and administrative services were provided. Extensive renovations were made to our headquarters buildings in St. John's to accommodate new staff and to upgrade laboratory facilities. Additionally, field stations at Badger, Pasadena and North Pond received considerable upgrading. This work resulted in a new nursery building at Pasadena and work storage buildings erected at Badger and Mount Pearl. Initial data input was undertaken with our new Materiel Management Information System (MMIS) which we expect to be fully operational in 1988-89.

Goals for 1988-89

To ensure that an effective accounting service is provided to all segments of the NeFC Research Program. To provide accounting and advisory services to management of NeFC. To make more effective use of the Financial Management System by providing a greater range of financial information to Management and users. To continue to prepare accounting and financial status reports on a timely basis. To implement the enhancements designed for the Financial Management Information System. To interface various aspects of Administrative Services with the VAX 8200.



Headquarters building in St. John's.

Program Management
and Support

Program Management and Support

Project 2111
Program Management
Project Leaders: R. S. van Nostrand and J. Hudak

Objectives

To ensure effective management of personnel and financial resources allocated to research programs and to maintain scientific and technology transfer elements of programs at a high level.

Achievements Current Year

New initiatives under the tree and stand growth project included cooperative research and consultative services to Dept. of Forestry in developing a wood supply model for the province. The work on calibrating the FORCYTE model continued and a major workshop on its use was held at the Centre. Environmental research was expanded to include studies to determine the impact of moose browsing on thinned balsam fir stands. *Kalmia* research was expanded through a three-year contract and two new contracted studies on energy plantations and the use of biomass for energy in Newfoundland were completed.

Detection, evaluation of impact and forecasting, with emphasis on major forest pests continued with improvements in several areas. The national system of detecting possible effects of acid rain was maintained. Surveys to detect plant feeding nematodes and their vectors was done, as was a survey for the pinewood nematode. Studies on pests of cones and seeds and an emphasis on plantation insects continued. Work on the population of the spruce budworm and the hemlock looper progressed with emphasis on biological mortality factors. Research on the relationship of severity of impact and defoliation pressure was maintained and a major effort continued on testing several products for the control of the hemlock looper. Biological control studies formed an important part of the program, primarily by determining the dispersal of introduced parasites in and near release areas.

Goals for 1988-89

Continue management and leadership responsibility for FRER projects. Maintain ongoing research and advisory and technology transfer services. Develop and initiate new project direction and studies in Biometeorology, Genetics and Forest soils. Manage five new ENFOR contracts. Continue committee involvement. Contribute to conferences and workshops. Continue direction and management of the FPR program emphasizing work on hemlock looper, balsam woolly aphid and spruce budworm, on pests of cones and seeds, on plantation pests and on tree deterioration. Guide the development of expert system (model) for the hemlock looper. Develop a 5-year operational plan. Continue to transfer research results to appropriate audiences through publications, workshops, seminars and contracts with the media. Maintain committee work.

Environmental Assessment of Forestry Practices

Project 2211
Environmental Assessment of Forestry Practices
Project Leader: I. D. Thompson

Objectives

To determine impacts of forestry management practices on terrestrial and aquatic systems; to assess the impacts of moose on second-growth forest including precommercially thinned stands, and to develop guidelines to minimize damage; to determine the impacts of forest harvesting on wildlife habitat and to provide guidelines for multiple use management; to provide advise and expertise to other agencies as requested.

Achievements Current Year

All browse impact plots from 1960 were resurveyed and one spacing trial was assessed for damage by moose relative to spacing. Work was begun to assess the impacts of browsing by moose on individual and stand growth and yield and two exclosures (from 1975) were surveyed for impact of moose browsing on growth and species composition of the second forest. A collection of twigs of balsam fir from trees in thinned and unthinned stands was done and processing begun to determine their chemical and nutritional content. Work continued on moose food preference studies and all radio locations from 1983-87 were coded and plotted on photographs and some initial variable measurement begun.

Thirty-year old white spruce dwarf same age balsam fir — an effect of moose browsing.

Goals for 1988-89

To census 180 plots at a spacing trial at Jeffries to determine damage by moose. To complete chemical analysis of twigs from 80 balsam fir trees to determine elemental, nutritional, and secondary compound components. To analyze tree species and height data collected at 16 sites and compare the results to those achieved for the same areas in 1960. To assess habitat variables at 50 locations of radio-collared animals in the Gander study area. To complete analysis of food preferences by moose in areas where fir is a major component by analyzing data from 80 transects. To prepare a habitat map for the Gander study area with a view to digitizing the data.

List of Studies

Guidelines for establishment of buffer strips
STUDY CLOSED
Leader - I. D. Thompson

Improved multiple use forestry
Leader - I. D. Thompson

Effects of moose on forest regeneration
Leader - I. D. Thompson

Moose exclosure at 12 years since establishment showing dense fir community behind wires and little growth in foreground.

Forest and Plant Ecology

Project 2214
Forest and Plant Ecology
Project Leader: W. J. Meades

Objectives

To determine the ecological relationships among major vegetation types of Newfoundland and Labrador and their natural environments; to provide a general system of site classification for forest and wildland habitats in Newfoundland and Labrador to assist resource managers in determining priority utilization for various resource development scenarios; to develop means of predicting gross successional changes in vegetation due to natural or human disturbances; to increase knowledge of the autecology of species having particular importance in Newfoundland and Labrador; to apply the data bank generated from such studies to forest and other land management problems; to provide national and international leadership and technology transfer in the development of ecological land classification systems.

Achievements Current Year

Survival, growth and foliage nutrient concentrations of trees on the peatland afforestation experiment was monitored and statistical analysis of data was initiated in consultation with statisticians at Memorial Univeristy. A final draft of a chapter on "Wetlands of Eastern Canada" was submitted to the Wetlands Working Group for a book on the Wetlands of Canada. Seed influx, black spruce seedling survival and vegetation succession on a black spruce experimental cutover in central Newfoundland was monitored. Assistance in site selection, vegetation and soil description was provided for the development of a factorial experiment involving site preparation techniques on a cutover dominated by *Kalmia angustifolia*. Work was initiated with the Newfoundland Department of Forestry on a site classification manual for insular Newfoundland.

Research on vegetation classification and succession after cutting continued with the description of 35 additional sites and analysis of 58 additional soil samples.

Forest site classification workshop.

Goals for 1988-89

To complete a forest site classification manual for insular Newfoundland in cooperation with the Newfoundland Department of Forestry under the Canada-Newfoundland Forest Resource Development Agreement. To complete work on cutover succession in western Newfoundland and analyze the results. To continue monitoring black spruce seedfall and viability on an experimental cutover in central Newfoundland. To monitor tree growth on peatland afforestation sites. To analyze data on central Newfoundland peatland plantation to initiate first draft of thesis.

To publish reports on the reproduction and regeneration of red pine and the distribution and growth of eastern larch. Study the ecology of soils, especially the micro-climate energy fluxes and changes in soil taxonomy in relation to disturbance by wind throw, and assess the forest capability on various soil types and develop guidelines for classification and effective soil management programs on soils of different depth.

List of Studies

Ecological investigation of wetlands for forestry
Leader - E. D. Wells

Ecological investigations of heathlands
Leader- W. J. Meades

Forest classification, ecology and mapping
Leader - W. J. Meades

Autecological studies of major trees, shrubs and related vegetation
Leader - B. A. Roberts

Ecology of Newfoundland soils
Leader - B. A. Roberts

Technology transfer - forest and plant ecology research
Leaders - W. J. Meades, B. A. Roberts, E. D. Wells
CLOSED

Reforestation

Project 2222
Reforestation
Project Leader: B. D. Titus

Objectives

To assess the effect of competition control on early softwood growth; to develop objective assessment methods and treatment criteria for identifying sites in need of management intervention; to develop silvicultural prescriptions for reforesting sites dominated by *Kalmia angustifolia;* to determine the performance of planting stock type and planting stock quality across a range of sites in Newfoundland; to determine the influence of site preparation on planting position microenvironment and subsequent seedling growth; to determine optimum softwood potential by matching species and provenance with site, and by genetic improvement of softwoods through hybridization.

Achievements Current Year

Some of the underlying site factors influencing the temporal and spatial establishment patterns of black spruce seedlings were identified and results published. Comprehensive statistical analysis of various spatial pattern relationships were completed and additional data acquisition activities were initiated for the development of treatment criteria to be employed within second-growth stands. A suitable *Kalmia* dominated site was located, and a major reforestation trial established; pre-treatment assessments of covertype, soil conditions, and decomposition rate were initiated. Two greenhouse experiments were begun to determine the effect of fertilizer on black spruce when planted amongst *Kalmia* and the effect of *Kalmia*-derived humus on black spruce and Jack pine.

Four site preparation field trials were planted and monitoring of decomposition rate initiated. Survival assessments after the first summer were completed and soil microenvironmental conditions following removal of slash, and slash plus the litter layer were monitored over the growing season. Also, three all-range tamarack provenance trials were planted.

Goals for 1988-89

Conclude data analysis for competition studies (1975-84 results for North Pond, 1978-84 results for South Brook Valley). Conclude study on regeneration survey methodology for recently disturbed sites. Complete establishment of *Kalmia* reforestation trial, and continue pre-treatment monitoring of site; repeat greenhouse experiments.

Bracke patch scarifier, used to create favourable planting locations.

Conclude data analysis for planting stock comparison and planting stock quality trials. Conclude data analysis for aerial seeding trial. Carry on with scheduled planting of the five site preparation field trials; complete first spring and second fall assessment of trials; continue microenvironmental monitoring.

List of Studies

Plantation Research
Leader - B. D. Titus, V. Chaffey

Site preparation research
Leader - B. D. Titus

Hybridization in conifers
Leader - Vacant

Species and provenance selection
Leader - Vacant

Reforestation of sites dominated by *Kalmia*
Leader - B. D. Titus

Afforestation of the Maritime Barrenlands
Leader - A. J. Mosseler

Young pine seedlings on burned site.

Tree and Stand Growth

Project 2223
Tree and Stand Growth
Project Leader: M. B. Lavigne

Objectives

To examine and assess the processes involved in tree growth and stand development for each commercially important tree species as a basis for incorporating site and stand factors into growth and yield models; to cooperate with the other major forest agencies in this province in setting out silviculture field trials for the purpose of producing good quality growth and yield data in the future; to interface with forest agencies to ensure effective transfer of research information and knowledge on data collection, tree and stand development and yield prediction; to conduct biometeorological research aimed at quantifying energy fluxes in forest ecosystems and conducting silvicultural experiments designed to transfer more of the net energy budget into forest growth.

Achievements Current Year

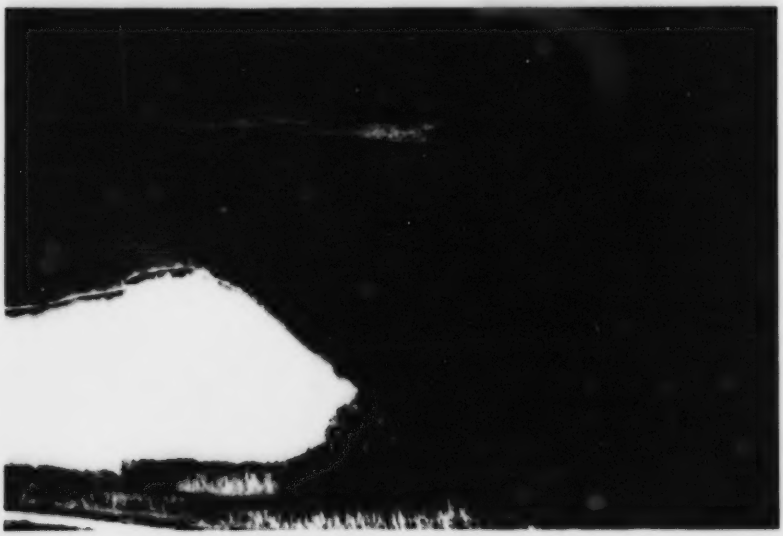
The five-year responses to precommercial thinning of one spacing trial were published. Remeasurements at one spacing trial were made and moose-browsing at another trial was assessed. Three planted spacing trials were established; one of these trials involved planting jack pine in combination with black spruce. Biomass measurements, including detailed measurements of crowns, and stem analysis were collected for sample trees at the remeasured precommercial thinning trial. The effects of spruce budworm defoliation on growth of black spruce in thinned and unthinned stands was analyzed and the results were published. A manuscript was prepared that reported on the modelling approach and data-handling procedures for the study relating growth of black spruce trees to density. Computer programs were written for general use for calculating individual tree and plot increments of stem parameters.

On-site transfer of research findings.

Results of the relationships of stem respiration rates to temperature and radial growth rates were published. The experiment involving the control of competition and supplies of water and nutrients was maintained by refreshing trenches, fertilizing, droughting and irrigating. Preliminary measurements of moisture relations of these trees were made. It is planned to continue treatments for one or two more years, allowing trees to respond to treatments before making the final measurements.

A PhD (Oxon) thesis, "the impact of wind on a balsam fir wave forest at Spirity Cove, Newfoundland" was completed.

Because of their predictable replicated patterns, wave forests provide a unique opportunity to study the effects of wind on the chronosequence of forest development, especially changes in biomass and wood quality.



Spirity Cove wave forest.

Goals for 1988-89

To remeasure three precommercial thinning trials. To establish a plantation spacing trial. To establish a precommercial thinning spacing trial. To make biomass measurements and do stem analysis at a precommercial thinning trial. To measure root biomass at a precommercial thinning trial. To prepare a report on black spruce responses to thinning. To analyze stand dynamics of black spruce. To evaluate the self-thinning rule. To develop a taper-based volume equation. To do growth analysis of black spruce trees in thinned and unthinned stands. To evaluate new methods for stem analysis.

Select two new sites, one in western Newfoundland and another in Iceland, to install energy balance measuring systems and operate, for the third consecutive year, such a system in central Newfoundland. Identify the effect wind has on the zonation of forest productivity and wood quality, especially its role in natural and artificially created wave

forests, plantations and precommercial thinnings. Select sites and plan silvicultural experiments designed to alter the energy fluxes and reduce adverse effects of wind to enhance forest growth and wood quality. Complete geobotany work and publish geobotany book.

List of Studies

Influence of stand density and fertilization on productivity of natural and planted softwoods.
Leader - M. B. Lavigne

Production processes in balsam fir stands
Leader - M. B. Lavigne

Development of a stand density management model for pure black spruce forest types within central insular Newfoundland.
Leader - P. F. Newton

Influence of biometeorological factors on forest productivity
Leader - A. W. Robertson

Advisory services to forest agencies for the production of growth and yield estimates
STUDY CLOSED

ENFOR (ENergy from the FORest)

Project 2241
ENFOR (ENergy from the FORest)
Project Leader: R. S. van Nostrand

Objectives

To determine the technical and economic feasibility of using forest biomass for energy production in Newfoundland; to assist the Department of Forestry (DOF) in developing long term strategies for the utilization of biomass for energy; to cooperate with DOF in developing methods and techniques for biomass inventory and management; to assess environmental impacts of biomass harvesting and methods of reforestation.

Achievements Current Year

P-299 — The final planting was completed and statistical analysis of data collected to date was completed. **P-172** — The *Salix* energy plantation work continued. In-fill was carried out on the Glenwood test block, and additional baseline biometeorological data were collected during July and August from this site. The data from the two year's baseline data was compiled and analyzed. A second energy balance measuring system was acquired. **P-264** — Testing of FORCYTE 10 on the VAX computer continued. A FORCYTE workshop was held at the NeFC for local industry and government scien-

tists and foresters. Dr. Kimmins, the developer of FORCYTE was the principal instructor. **P-362** — An economic analyses of the competitive position of fuelwood from proposed energy plantations in Newfoundland, was completed. **P-363** — A review of forest biomass used for energy in Newfoundland was completed.

One-year-old willow plantation at the Pasadena Nursery.

Goals for 1988-89

3401 (P-299): To coordinate the monitoring of the field trial and prepare results to date for publication. **3402 (P-172):** In-fill and tend established plantations, conduct additional energy balance studies, establish additional test plantations in cooperation with Dept. of Forestry, and extend national and international R&D cooperation. **3403 (P-264):** Collect additional field data from softwood and hardwood stands and continue calibrating and testing the FORCYTE model. To develop ENFOR project proposals for 1989-90.

List of Studies

Reforestation after whole-tree chipping for hog fuel
Leader - B. D. Titus

Boreal energy plantation R&D
Leader - A. W. Robertson

Calibrating the FORCYTE growth model for Newfoundland forest types
Leader - W. J. Meades

Energy plantation model
STUDY CLOSED
Leader - A. W. Robertson

Forest biomass energy use in Newfoundland
Leader - G. R. Milne

Forest Protection Research

Pest Biology Research

Project 2232
Pest Biology Research
Project Leader: A. G. Raske

Objectives

To develop effective and practical methods for measuring population levels of forest pests and their natural control factors; to investigate the biology of pest insects and diseases including their population dynamics; to assess insect and disease impacts on major age classes of forest trees and stands; to develop methods to prevent or minimize forest losses.

Achievements Current Year

Hemlock Looper – Studies on the hemlock looper formed the major portion of the research program. Population dynamic studies continued in 1988, and the population at two plots was sampled weekly for looper density, for development, for incidence of parasitism, disease, predation, and other mortality factors. Fungi were important in population reductions at both plots, but two different species of fungi were responsible in each area sample. As in past years predation of larvae and pupae was not important.

Efforts continued to refine the sampling systems used to forecast severity of infestations. Additional data on hemlock looper egg distribution and data relating egg numbers to resulting defoliation was added to the data base for re-calculations. Thus sampling systems have been put on a firmer mathematical base.

Female-baited trap for catching male hemlock looper moths.

Studies of the reproductive biology of the hemlock looper were initiated with investigations on mating and pheromone release.

Stands damaged by the hemlock looper continued to be monitored for rate of tree mortality and rates of blowdown and deterioration of standing and blowdown timber. Sampling to determine the succession of fungal communities responsible for tree deterioration is continuing.

Aerial application of new insecticide formulations were tested against the hemlock looper. Experiments with *B.t.* (Dipel 176, Dipel 264, and Futura XLV) formed the bulk of the program and studies on the efficacy of oil formulations of Dimilin (an insect growth regulator) rounded out the experiment. Reduction in larval numbers for Dipel was generally greater than 80% except for one spray when rains shortly after the spray may have reduced efficacy. Larval reduction by Futura was only 22% after 10 days, but increased to 68% 21 days after treatment. Dimilin did not reduce early larval instars, but late-instar larvae were considerably reduced.

Field crew for the 1988 experimental spray program against the hemlock looper. A Grumman AgCat aircraft was used during the experimental spray program in western Newfoundland.

Initial contract research with NORDCO Ltd. showed that several classes of hemlock looper defoliation may be detected with satellite imagery. The results given by the new spectral bands look promising, and it may be possible to develop a useful survey tool with this technology.

Some work was done to identify the sex pheromone of the hemlock looper. Large samples of female pupae collected the previous year enabled the separation of several compounds. One compound was highly active in electro-antennograms in the lab, but field tests proved negative in attracting males. Further work using air extracts, instead of gland contents, has been initiated.

Spruce Budworm — Only remnants of high populations of the spruce budworm remained in Newfoundland. Factors that influence population levels continued to be monitored in these populations. The data of several years is being analyzed for patterns of relationships. Data continued to be gathered on the past impact of this insect, and stem analysis continued on selected trees. Foliage loss per branch caused by 5th-6th instar larvae has been determined, and a damage function relating wood increment to defoliation intensity has been determined for young balsam fir trees. Collation of data to refine existing sampling systems continued as new data to the data base.

Sampling spruce budworm impact plots: removing disks at various tree heights for tree growth analysis.

The work on rate of tree deterioration of budworm-damaged balsam fir, deterioration pathways, and the interaction of decay fungi has now been completed.

Generally there was an increase in larval numbers of the budworm in western Newfoundland, though numbers remained well below those of outbreak populations. Pheromone-baited traps caught some moths in western trap sites, but no moths were trapped in central and eastern Newfoundland except for the trap site on the Baie Verte Peninsula.

Balsam Woolly Aphid — Balsam woolly aphid populations in western Newfoundland continued to rise, warranting a new emphasis on this pest. Field experiments were established to improve the sampling system for the aphid and to assess the effect on the growth of young, thinned balsam fir stands. Studies on the basic biology in thinned stands were also initiated. Insect growth regulators were field tested against the balsam woolly aphid and generally high dosages of these types of pesticides provided reduction of sessile nymphs.

Sampling balsam woolly aphid in a thinned balsam fir stand.

Other Forest Pests — A seed extraction and germination procedure were developed. Studies on yields of seeds from insect-damaged cones are continuing. Studies on population levels of red squirrels have related squirrel density to cone losses. Other cone insect studies include development of pheromones of the spruce coneworm and that of the spruce seed worm for use in building survey systems.

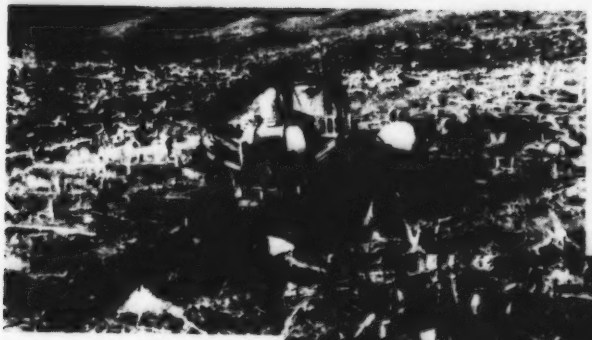
Defoliation of young unthinned balsam fir.

Studies on the impact of squirrel populations on cones and seeds of spruce continued in 1988. Squirrel densities were measured again and data on cone crop abundance taken.

Potential insect vectors of plant feeding nematodes were collected from sites across the province and shipments of potential insect vectors were received from all provinces of Canada. Nematodes were extracted from these insects and the nematodes are being reared to maturity for identification. None of the vectors examined to date carried the pinewood nematode. Similarly, wood samples were also collected and examined for plant feeding nematodes, with a large number of samples collected this year in Labrador.

Acecaps, a capsule containing a systemic insecticide, were implanted into black spruce bark to develop management strategies for dealing with pest populations of the four-eyed spruce bark beetle. Tests determined the effectiveness of this material as a preventative, and as a control for beetles and their brood under the bark.

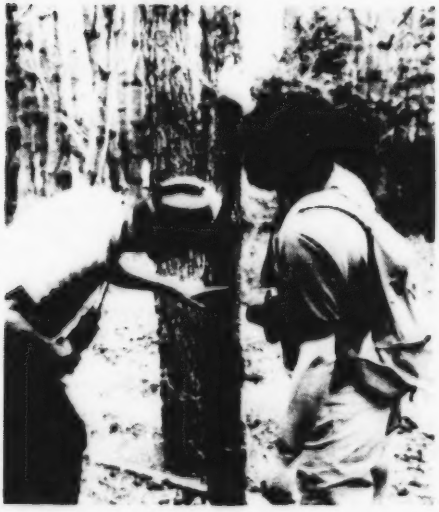
The black army cutworm continued to cause tree mortality in recent spruce plantations established on recently logged and burnt areas. The limits of the adult flight periods is being established, the food preferences of the larvae determined, and damage estimates obtained. Trials were initiated in 1988 to use insectivorous nematodes to control this cutworm. Data was also gathered to develop a sampling system for this insect based on young larvae.



Spraying against the black army cutworm, with an automatic mist blower mounted on a tree farmer.

Sampling larvae of the black army cutworm.

The incidence of Scleroderris canker increased in and around St. John's. Continued surveys also recorded the disease in four new locations: three around St. John's and one in an old Scots pine plantation on the Salmonier Line. In addition efforts were made to locate all Sitka spruce plantations established using seedlings from New Brunswick. Many of these plantations were inspected and most were in poor condition. Only the plantation near Roddickton had the symptoms and signs of Scleroderris canker. Fungi from branch samples are being cultured for verification.



Scleroderris basal stem canker on Scots pine.

Black spruce plantations with decline symptoms of red old foliage in 1986, caused by warm and early spring winds, were monitored for persistence of damage in 1987. Recovery of foliage was good and growth did not seem to be affected.

Armillaria root rot fruiting bodies around root collar of fire killed black spruce.

Tables on gross and net merchantable volumes, by Management Unit, have been updated for wood density and identifications of decay causal organisms are complete. Work is continuing on the stratification of the province into natural forest regions based upon gross and net merchantable volumes and on wood density. Susceptible cull regions are being examined for heartrot and butt rot.

Goals for 1988-89

To continue germination tests of seed from insect damaged cones and to continue studies of the biology, including pheromones, of seed pests. To continue studies on midge ecology and its chemical control with systemic insecticides. To examine the sampling system for the balsam woolly aphid and formulate plans for direct control experiments and for assessing impact on growth of thinned stands. To report the investigation of the distribution and severity of *Armillaria* in the roots of balsam fir damaged by the spruce budworm and to resample damaged black spruce stands. To continue studies of deterioration of black spruce and the associated microflora and insect activity. To investigate wood losses due to blowdown and subsequent deterioration in insect damaged stands, and to continue sampling utility poles for active decay. To update analysis of the data base to identify site and stand variable for a natural stratification

of cull regions in Newfoundland. To finalize studies on the impact of the four-eyed spruce bark beetle on damaged black spruce. To investigate the use of Acecaps in combination with beetle pheromone to control the four-eyed spruce bark beetle. To finalize the pheromone studies of the four-eyed spruce bark beetle. To describe the population dynamics of the spruce budworm and the hemlock looper on the accumulated data base. To continue monitoring spruce budworm population and their natural control factors. To continue growth ring analysis of budworm-damaged trees. To remeasure permanent plots for determining changes in forest succession. To test a new formulation of Dimilin and several treatments of *B.t.* against the hemlock looper. To continue efforts to identify the sex pheromone of the hemlock looper. To field test the effect of *B.t.* on parasites of the hemlock looper.

Black spruce butt rot windthrow damage.

List of Studies

Factors damaging to cone crops
Leader - R. J. West

Plantation and regeneration pests
Leaders - R. J. West and G. R. Warren

Balsam woolly aphid
Leader - E. J. Dobesberger

Armillaria root rot
Leader - Vacant

Deterioration of insect-damaged trees
Leader - G. R. Warren

Decay and wood quality of living trees
Leader - G. R. Warren

Role of woodborers and bark beetles in tree mortality and deterioration
Leader - W. W. Bowers

Population studies of major defoliators
Leader - E. J. Dobesberger

Biocontrol factors of major defoliators
Leader - K. P. Lim

Impact of major defoliators
Leaders - A. G. Raske and E. J. Dobesberger

Impact of spruce budworm on forest succession in Newfoundland
Leader - W. J. Meades

Effectiveness of insecticides
Leaders - A. G. Raske, R. West and K. P. Lim

Sex pheromone(s) of the eastern hemlock looper
Leader - K. P. Lim

Biological Control Research

Project 2234
Biological Control Research
Project Leader: P. L. Dixon

Objectives

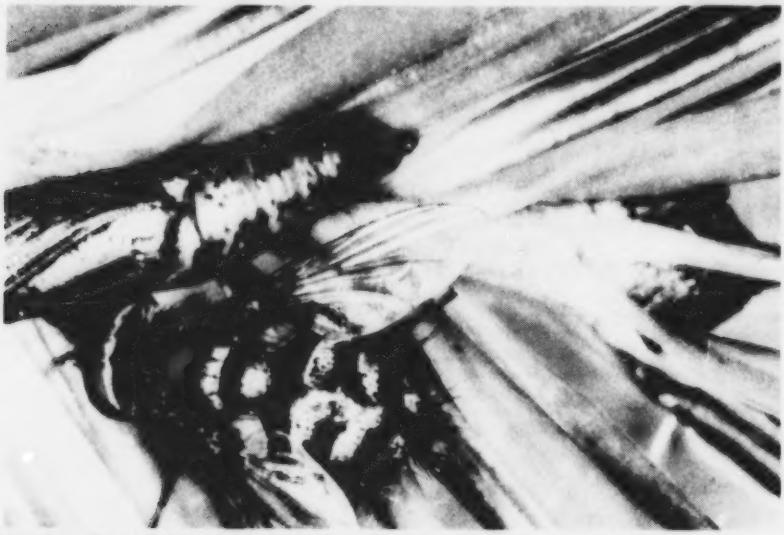
To develop effective biological control of forest insect pests; to investigate the potential of parasites, fungi and nematodes in biological control; to evaluate the effect(s) of chemical insecticides on parasites of forest pests.

Achievements Current Year

Mountain-ash sawfly larvae were collected from about 100 sites in the St. John's area and dissected to determine the rate of parasitism by the introduced parasite *Olesicampe geniculatae*. Parasitism ranged from 0-80% depending on distance from the release site at Oxen Pond Botanic Garden. Birch casebearer samples collected near Gambo indicate the introduced parasite is spreading slowly. Parasitism was 97% at the release site and 6% at approximately 8 km distant. Casebearer- and hopefully parasite-infested branches were relocated to Millertown, Badger, and Pasadena to assist parasite spread. NPV (virus) was applied by FIDS personnel to all known local infestations of the European pine sawfly, and was very effective.

Studies continued on *Winthemia occidentis*, the introduced tachinid fly parasite of the hemlock looper. Ten Malaise traps were operated at five locations across Newfoundland, including Fenitrothion-treated areas on the Northern Peninsula. Trap material should provide information on the phenology of *W. occidentis*, and on effects of

Fenitrothion. Several hundred tachinid larvae were reared from field-collected looper. These are currently in diapause and if over-wintered successfully will be used to establish a laboratory colony.



***Winthemia occidentis*, a parasitic fly introduced against the hemlock looper.**

Goals for 1988-89

To continue monitoring the spread of the introduced parasite of the birch casebearer and to introduce another parasite, *Agathis cincta*. To monitor the establishment of introduced parasites of the larch sawfly should this pest occur. To continue lab and field studies of *Winthemia occidentis*. To re-activate research contracts on entomogenous nematodes and fungi.

Malaise trap used to capture adult parasites.

List of Studies

Populations of introduced biological control agents
Leader - P. L. Dixon

Control of forest insect pests with nematodes and fungi
Leader - P. L. Dixon

Insecticides and parasitoids of the hemlock looper
Leader - P. L. Dixon

FIDS (Forest Insect and Disease Survey)

Project 2311
FIDS (Forest Insect and Disease Survey)
Project Leader: J. Hudak

Objectives

To conduct annual surveys of forest pest conditions, determine the extent of infestations, assess the impact, forecast impending conditions, and recommend control measures and when necessary evaluate the effectiveness of direct control measures. To provide forest pest data and related information for the National Forest Resource Data program of Canada and other national and regional reports.

Achievements Current Year

The annual general detection, monitoring, appraisal and forecast of forest insects and diseases have been completed, the data analyzed and interpreted, and presented to forest resource managers in the form of publications, reports, and at special seminars and meetings. Data from the above surveys provided resource managers with the information necessary to evaluate the problem and to plan and conduct the control action necessary. Information on many forest pests was provided including details of the three important pests in 1986; the hemlock looper, the spruce budworm, and the balsam woolly aphid.

The hemlock looper replaced the spruce budworm as the most important defoliating pest of Newfoundland's forest. Populations continued at outbreak levels especially in western areas of the Island. Moderate and severe defoliation is forecast for 118 000 ha.

Taking a beating sample of the hemlock looper.

Spruce budworm populations in 1987 were high at three locations on the Island and moderate and severe defoliation occurred on about 4 000 ha with 2 000 ha in the light category. Generally, larval numbers increased in western Newfoundland. Fifty permanent sites were sampled for budworm populations with pheromone-baited traps.

Branch samples were collected throughout the Island to adopt a method for counting balsam woolly aphids in immature thinned and natural stands.

Special pheromone baited traps were used, in cooperation with Agriculture Canada, to monitor the possible accidental introduction of the Gypsy moth and forest tent caterpillar. One Gypsy moth was trapped near Corner Brook but no forest tent caterpillar moths were caught in traps in Newfoundland in 1987.

A special survey was conducted in cooperation with Memorial University to sample insect vectors of pinewood nematodes in forest trees.

Several experimental plantations of Sitka spruce were examined for Scleroderris canker throughout the Island. This disease continued to spread in St. John's and a major extension of its range in Newfoundland occurred when an outbreak was discovered near Salmonier Line, which is outside of the quarantine zone. Permanent sample plots established for the early detection of acid precipitation were monitored thorughout the Island.

FIDS staff assisted in testing the effectiveness of fenitrothion, and dimilin against the eastern hemlock looper, in developing a sampling system for forecasting hemlock looper defoliation and in determining the usefulness of satellite imagery for assessing defoliation.

Goals for 1988-89

Continue surveys for detecting, appraising and forecasting forest pest conditions in general and with special emphasis on spruce budworm, hemlock looper, balsam woolly aphid, Scleroderris canker, and general pest conditions in forest improvement areas.

Disseminate information to forest agencies and the general public through written papers, reports, seminars, workshops and verbal communications.

Provide information on forest pests for inclusion in national publications.

List of Studies

Detection and forecasting forest pest conditions
Leaders - L. J. Clarke, and G. C. Carew

Forest Development

Program Management

Project 3111
Program Management
Project Leader: J. M. Butler

Objectives

To provide management and common support services to the Forestry Development Branch at NeFC; to recruit and train appropriate staff to discharge the development responsibilities of the branch.

Achievements Current Year

An organizational change took place in the Forestry Development Branch. The Economics unit, which previously reported to the Program Director, Forestry Development, now reports to the Regional Director General.

Goals for 1988-89

To continue to provide Management support for the unit. The Program Director will attend an intensive three-week management training course this year.

Canada-Newfoundland Forest Resource Development Agreement

Project 3212
Canada-Newfoundland Forest Resource Development Agreement
Project Leader: J. M. Butler

Objectives

Through the three main Agreement Programs: Forest Resource Management, Research and Development, Opportunity Identification; Technology Transfer; and Administration, Communications and Evaluation, initiatives in support of the intensive management of Newfoundland's forests will continue. The main focus will be on correcting predicted future timber shortages, thereby ensuring future employment opportunities in the forest sector.

Forest access road.

Achievements Current Year

In 1987-88, approximately $13.5 million was spent on Agreement activities. This was dispersed over the three main programs. Major achievements for the second year of the Agreement include the silvicultural treatment of approximately 13 169 ha of forest land; the construction of 97 km of forest access road; the expansion of the Geographic Information System including the installation of computer terminals in Forest Management Unit Offices, and the continuation of support to the Forest Insect and Disease Survey Program which provides up-to-date information on insect populations in the Province. Research and Development was also carried out in silviculture, forest industry development, forest inventory and forest insect control.

Goals for 1988-89

Targeted expenditures for 1988-89 total $12.5 million. Included in this are the treatment of an estimated 19 730 ha of forest lands, the construction of 67 km of forest access roads and the expansion of the Geographic Information System into Forest Management Units 2, 5 and 17. In addition, research and development projects will continue in the fields of silviculture, forest inventory, forest products and forest protection. The private woodlot pilot project has targeted another twelve woodlot management plans for development. Technology transfer programs aimed at forest product development, improved road building techniques and introducing new silviculture technology to the Province will continue. In addition, work will continue on the development of a timber supply model for the Province and continued emphasis will be placed on human resource development through educational training, etc. Finally, efforts will continue to raise the public awareness of forestry in the Province through the public relations program.

Wooddale tree nursery.

List of Studies

Forest Renewal

Forest Improvement

Forest Access Roads

Forest Management and Inventory

Forest Fire Management

Insect and Disease Protection

Research and Development

Opportunity Identification

Technology Transfer

Federal Administration

Federal and Provincial Communications

Human Resource Development

Economics and Agreement Coordination

Evaluation

Agreement Administration (CFS Resource)

Project 3251
Agreement Administration (CFS Resource)
Project Leader: J. M. Butler

Objectives

To discharge federal responsibilities for the implementation and evaluation of Forestry Agreements in Newfoundland; to facilitate the transfer of new technology into the forestry sector in Newfoundland; to implement forestry job creation programs as required.

Achievements Current Year

Continued management responsibilities for the Forest Resource Development Agreement. Approximately $13.5 million was spent under the Agreement's three programs. To date $24.0 million has been spent.

The Forest Management Information System was refined and is now fully operational.

Technology transfer continued, particularly in areas of silviculture, forest products development, access roads construction, and forest inventory.

The agreement requires a sophisticated administrative and evaluation process.

Goals for 1988-89

Continue management and evaluation responsibilities for FRDA. Approximately $12.5 million will be spent on intensive forest management projects, operational research and development, and Agreement administration, communications and evaluation. Continue to assist in the transfer of technology from outside Newfoundland, particularly in the areas of silviculture, forest products development, access roads construction, and forest inventory. Continue involvement in forestry employment development programs as required.

List of Studies

Agreement implementation and technology transfer
Leader: J. M. Butler

TTS Disc Trencher used for preparing planting sites.

Advice and Consultation Services

Project 1333
Advice and Consultation Services
Project Leader: G. R. Milne

Objectives

The objectives of this project are to: provide ongoing advice on forest policy, planning and economics to clients within the NeFC and externally such as industry and other government agencies; represent the NeFC on regional and national committees in support of ongoing CFS activities relating to forest policy, economics and statistics; provide functional services to staff and management of the Forestry Development Branch in the planning, negotiation and evaluation of Forest Resource Development Agreement (FRDA) and related initiatives.

Achievements Current Year

Ongoing progress continued to address the broad objectives of this project. Main clients included the provincial Department of Forestry, and NeFC management.

Goals for 1988-89

The project goal for 1988-89 is to continue to provide advisory and consultation services as required to meet regional and national demands. Principal areas of work will include planning at the NeFC and FRDA evaluation.

List of Studies

Advice and consultation services
Leader - G. R. Milne

Economic Studies

Project 1334
Economic Studies
Project Leader: G. R. Milne

Objectives

The general objectives of this project are to: conduct economic research on specific resource and industry problems in the region; prepare reports and articles of high scientific and professional standard for publication and distribution to the appropriate authorities; provide regional input and expertise to the CFS National Forest Economics Program.

Achievements Current Year

The senior economist returned to NeFC and a second economist was hired in the spring of 1987. Consequently, 1987-88 has been a year for rebuilding this project, becoming familiar with Newfoundland's forest sector, and developing research priorities. The planning phase of a long-term study to analyze the economic effects of forest based industries on the Newfoundland economy was completed. A cooperative research project between the provincial Department of Forestry and the NeFC was established to develop improved methods of projecting Newfoundland's forest inventory and economic timber supply. The economist also completed research on the effects of biotechnology on the Canadian dairy industry which carried over from his previous employment with Agriculture Canada in Ottawa.

Goals for 1988-89

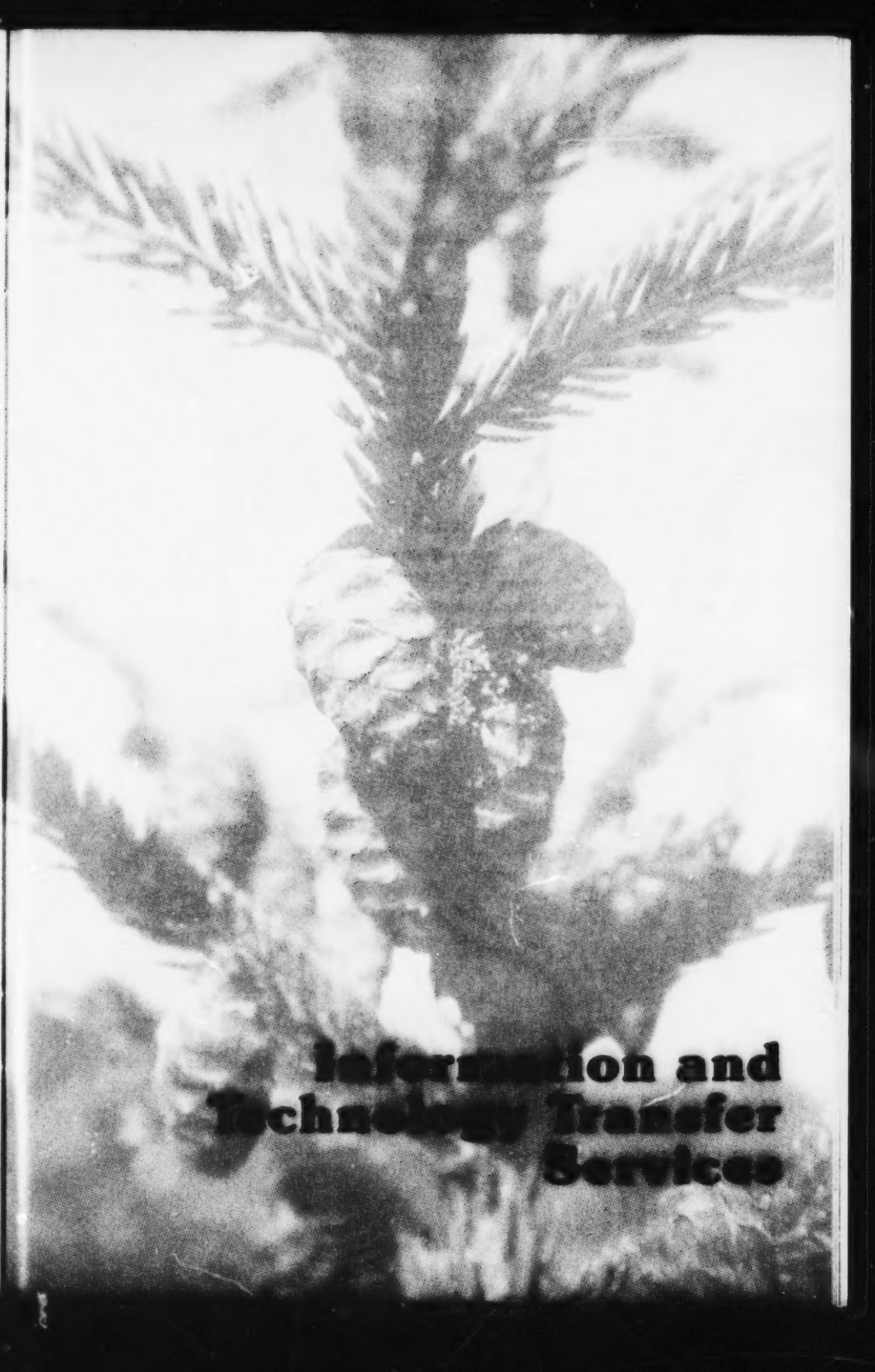
The project goals for 1988-89 are to improve the level of economic information on Newfoundland's forest industry and resource base by meeting the specific goals identified for each of the three studies.

List of Studies

Effects of the forestry industry on the provincial economy
Leader - P. M. Trelawny

National forest economics program
Leader - G. R. Milne

Economic research of the provincial forest resource
Leader - G. R. Milne


Information and
Technology Transfer
Services

Information and Technology Transfer Services

Project 2313
Information and Technology Transfer Services
Project Leader: D. R. Rex

Objectives

To provide information to our client groups about policies, programs and services of the CFS, that is accurate, complete, timely, relevant, objective and understandable; to ensure that CFS programs and activities are visible, accessible and respond to the needs of principal client agencies and the general public within the Newfoundland and Labrador region; to evaluate the effectiveness of communications efforts of CFS within the region.

Achievements Current Year

During 1987-88 approximately 210 k was spent on various communications projects in support of the Canada-Newfoundland Forest Resource Development Agreement (FRDA) and the Centre's research programs. Highlighting our publications program was the production of ten information reports and five editions of the "Woody Points" newsletter. The mailing lists for both series of publications were reviewed and subsequently reorganized resulting in a higher level of accessability. An extensive advertising and promotional campaign was carried out under the forestry agreement (FRDA) in cooperation with the Provincial Department of Forestry. Traditional activities of the Communications Unit such as support to headquarters, minister's office, Newfoundland Forest Protection Association, environmental associations and the education community continued as in past years as was liaison with technical clients.

Goals for 1988-89

Technology transfer initiatives in support of the Centre's research program will be increased. Other communications' activities ongoing in 1987-88 will be maintained and/or expanded as resources permit.

List of Studies

Public information/media relations
Leader - D. R. Rex

Publication/editorial services
Leader - D. R. Rex

Extension services
Leader - D. R. Rex

Staff members who helped promote forestry during NFW '87 at the Village Mall. L-R: H. Dunphy, G. Carew, P. Libbey, L. Clarke, and D. Rowe.

Cub Scouts attentively watching a video during a tour of the Newfoundland Forestry Centre.

General Research
Support Services

General Research and Technical Support

Project 2251
General Research and Technical Support
Project Leaders: R. S. van Nostrand and J. Hudak

Objectives

To provide an efficient and high quality support service to meet the needs of the NeFC research and development program.

Achievements Current Year

Seed and Plant Stock Service — Produced research plantings for three *Salix* energy plantations and maintained native and exotic transplants for the tree improvement project.

Chemical and Physical Analyses Laboratory — Provided soil and vegetation analysis services to in-house researchers.

Plant Herbarium - Non-vascular checklist was not published due to time and labour constraints.

Greenhouse Facility - Installed arctic coolers for large experimental chamber; provided maintenance services for ongoing research experiments at the greenhouse.

Computer Services - Electronic Data Processing services continued to be provided to staff. In-house training was provided as required and a formal SAS/BASICS and SAS/GRAPH training session was presented for those interested. The Sydney Library System was installed towards the end of the year, as was the Materiel Management Information System (MMIS). The MMIS system is still undergoing changes but will be operational in 1988-89.

Mycological Herbarium - Many disease samples have been identified and new additions have been made. Also the slide collection has been improved by new additions or better replacements.

Insect Reference Collection - New additions were made to the collection of the native forest insect fauna of the Island. Special cataloguing was completed to enable quick referencing to any species.

Goals for 1988-89

Seed and Planting Stock Supply Service - To maintain research nursery transplants for *Salix* energy and tree improvement projects. Provide landscaping service and transplant material for improvements to NeFC properties.

Chemical and Physical Analyses Laboratory - Continue the soil and plant analyses service to in-house researchers.

Plant Herbarium - To publish non-vascular checklist; to improve and maintain the reference collection and expand the herbarium.

Greenhouse Facility - To continue greenhouse services for ongoing research.

Computer Services - To continue to provide the required electronic data processing services. To upgrade both internal and external communications systems, and to upgrade graphics facilities. To increase training provided to users and obtain more training for computing staff.

Mycological Herbarium - To continue to enlarge and improve the herbarium, and the slide collection of forest diseases of Newfoundland.

Insect Reference Collection - To continue to improve and expand the regional insect reference collection.

List of Studies

Seed and planting stock supply service
Leader - A. W. Robertson

Chemical and Physical Analyses Laboratory
Leader - D. G. Trenholm

NeFC Botanical herbarium
Leader - S. M. Morgan

Greenhouse facility
Leader - G. J. Mills

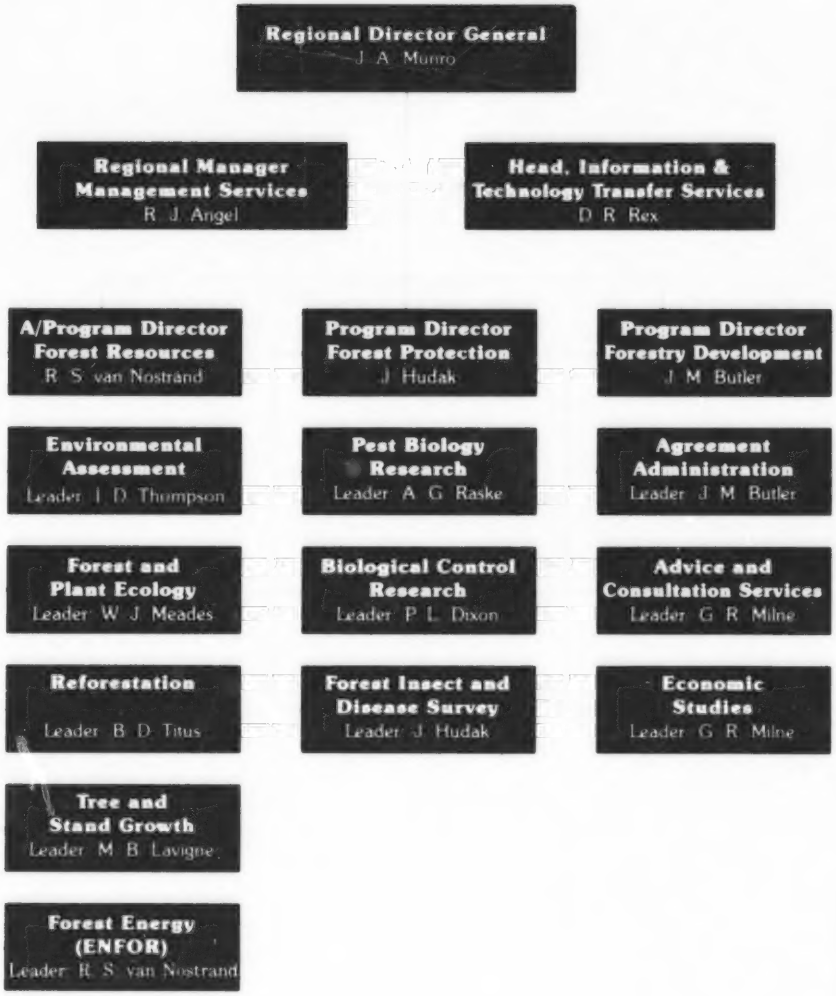
Computer services
Leader - R. G. Hunter

Mycological herbarium
Leader - G. C. Carew

Insect reference collection
Leader - K. E. Pardy

Appendices

Newfoundland Forestry Centre
Program Organization



Staff List and Organization 1987-88

Regional Director General - Dr J. A. Munro — Secretary - E. E. Manuel

Forest Resources and Environmental Research

A/Program Director - R. S. van Nostrand

Chemical and Physical Analyses Laboratory	—	.....	D. G. Trenholm, E. M. Pike, G. Waterman
Forest Ecology	—	Site/Succession.....	W. J. Meades, A. R. van Kesteren
	—	Soils/Autecology	B. A. Roberts
	—	Wetlands.....	E. D. Wells, S. M. Morgan
	—	Impact Assessment	I. D. Thompson, W. J. Curran
	—	Herbarium	S. M. Morgan
Growth and Yield	—	Ecophysiology/ Stand Modelling	M. B. Lavigne, J. G. Donnelly
	—	Stand Development.....	P. F. Newton, L. May
	—	Mensuration/Biomass	Vacant
	—	Biometeorology, Energy Forests	A. W. Robertson, C. T. French
Forest Renewal	—	Tree Improvement/Genetics	P. Tricco
	—	Site Preparation/ Stand Establishment	B. D. Titus, V. Chaffey
	—	Nursery Services.....	A. W. Robertson
	—	Greenhouse/ Special Projects	G. J. Mills

Protection Research

Program Director - Dr. J. Hudak

Insect Populations	E. J. Dobesberger, J. Carter
Cone, Seed and Plantation Pests.....	R. J. West, D. S. Durling
Bark Beetles.....	W. W. Bowers, J. W. Marshall
Damage and Impact.....	A. G. Raske, J. D. Rowe
Biological Control.....	K. P. Lim, P. L. Dixon, L. Oldford
Mycology, Pathology	G. C. Carew
Wood Deterioration and Decay	G. R. Warren, J. P. Meades, A. L. Fudge
Computer and Statistical Analysis.....	R. G. Hunter, B. E. Galloway
Forest Insect and Disease Survey	L. J. Clarke, K. E. Pardy, E. C. Banfield, D. S. O'Brien W. J. Sutton, D. M. Stone

Development Branch

Program Director - J. M. Butler

Senior Development Officer	Vacant
Forest Development Officer	W. L. Alexander
Forest Development Officer	L. R. West
Secretary	M. A. Grandy

Economics

Chief, Policy Planning and Economics	G. R. Milne
Economic Analyst	P. M. Trelawny

Information and Technology Transfer Services

Head - D. R. Rex

Public Information	P. A. Libbey (term)
Information Clerk	Vacant
Information Officer	Vacant

Management Services

Regional Manager - R. J. Angel

Finance	W. F. Walsh, E. C. Higdon, M. A. Martin, C. G. Prior
Purchasing	F. L. Bannister, J. J. Healey
Personnel	J. A. Macfarlane
Library	C. E. Philpott
Central Registry	L. J. Fennelly
Office Services	M. F. Gillingham, H. M. Dunphy
Field Station Facilities	W. V. Bonnell

Research Project Contracts 1987-88

Contractor	Title	Amount ($)
Delta T Documents OIK24-7-0131	Construct and deliver energy balance measuring system.	$10,045.00
Northland Assoc. Ltd. OIK24-7-0034	Supply data for calibration of the Forcyte 11 Growth . . . western Nfld.	10,000.00
David Higdon OIK24-7-0149	Develop and test a user friendly software package for a computerized tree nursery inventory system.	3,500.00
D. B. Pike OIK24-7-0005	Forcyte stimulation studies.	21,700.00
Memorial University of Newfoundland OIK24-7-0150	To carry out statistical analysis of ENFOR II data.	1,500.00
John Farrell OIK24-7-0139	To carry out data analysis and presentation.	4,500.00
Memorial University of Newfoundland OIK24-7-0094	Determination of parasitic nematodes in forest trees of Nfld. & Labrador.	30,000.00
John Farrell OIK24-7-0092	To construct and provide 600 ion exchange resin bags.	3,990.00

Newfoundland Forestry Centre
Expenditures ($000) 1987-88

Program Areas	PY	Salaries	Development Agreement	Development Agreement O&M	Challenge '87	ENFOR	PRUF	O&M	Capital	Job Creation	Totals
Management	2.64	99.5						19.8			119.3
Administration	15.87	445.4						272.1	527.2		1,244.7
Forest Resources	20.69	875.2			36.2	74.9		165.5			1,151.8
Forest Protection	23.89	951.4			22.6			228.2			1,202.2
Forest Development	4.0	168.1	9,175.0	219.1				36.7			9,598.9
Economics	2.0	77.0						3.2			80.2
Technology Transfer/ Information Services	1.42	54.6			4.0			51.9			110.5
Total	70.51	2,671.2	9,175.0	219.1	62.8	74.9		777.4	527.2		13,507.6

Publications

Publications

Clarke, L. J. and G. C. Carew. 1987. Forest insect and disease conditions in Newfoundland and Labrador in 1986. Can. For. Serv., Newfoundland For. Centre, Info. Rep. N-X-259. 36 pp.

Dowsley, Barbara J. 1987. Study of the correlation of diurnal growth patterns to climatic variables in a *Salix* energy plantation. Can. For. Serv., Newfoundland For. Centre, Info. Rep. N-X-260, St. John's, Nfld.

Dowsley, Barbara J. 1987. Study photosynthetically active radiation and leaf development in a *Salix* energy plantation. Can. For. Serv., Newfoundland For. Centre, Info. Rep. N-X-261, St. John's, Nfld.

Grant, G. G., Y Prévost, K. N. Slessor and R. J. West. 1987. Identification of sex pheromone components of the spruce coneworm, *Dioryctria reniculelloides* Muturra and Munroe (Lepidoptera: Pyralidae). Environ. Entomol. 16:905-909.

Langor, D. W. 1987. Flight muscle changes in the eastern larch bettle, *Dendroctonus simplex* LeConte. Col. Bull. 41(4):351-357.

Langor, D.W. and A.G. Raske. 1987. Emergence, host attack, and overwintering behavior of the eastern larch bettle, *Dendroctonus simplex* LeConte (Coleoptera: Scolytidae), in Newfoundland. Can. Ent. 119:975-983.

Langor, D. W. and A. G. Raske. 1987. Reproduction and development of the eastern larch bettle, *Dendroctonus simplex* LeConte (Coleoptera: Scolytidae), in Newfoundland. Can. Ent. 119:985-992.

Lavigne, M.B. 1987. Differences in stem respiration responses to temperature between balsam fir trees in thinned and unthinned stands. Tree Physiology 3:225-233.

Lavigne, M. B., J. G. Donnelly and R. S. van Nostrand. 1987. A spacing trial in a precommercially thinned stand of black spruce at North Pond: stemwood production during the first five years after thinning. Can. For. Serv., Newfoundland For. Centre, Info. Rep. N-X-262. 15 p.

Mallik, A. U. and P. F. Newton. 1987. Seedbed inhospitality. Note independently published in the Journal of the New Forest Silviculture 2:26.

Mallik, A. U. and P. F. Newton. 1988. Inhibition of black spruce seedling growth on the forest-floor substrates of central Newfoundland. Forest ecology and management 23:273-283.

Murrin, F. and R. A. Nolan. 1987a. Ultrastructure of the infection of spruce budworm larvae by the fungus *Entomophaga aulicae*. Can. J. Bot. 65:1694-1706.

Newton, P. F. 1987. Initial response of partially defoliated black spruce trees to operational precommercial thinning. Seminar presented to the CFS Modelling Working Group during its 3rd Annual Meetings at PNFI, Chalk River, Ont., 27-10-1987. *In* Proceedings of the 3rd Annual Modelling Workshop, ed. J. Richardson, 7 pp.

Newton, P. F. 1987. Development of a stand density management model for black spruce forest types within central Newfoundland. I. Applicability of the self-thinning rule. Pages 604-610 in A. R. Ek, S. R. Shifley and T. E. Burk, eds. Forest growth modelling and prediction: proceedings of the IUFRO Conference August 23-27, 1987, Minneapolis, Minnesota. USDA, For. Serv. Northcent. For. Exp. Stn., Gen. Tech. Rep. NC-120.

Raske, A.G. and A. Retnakaran. 1988. The effectiveness of diflubenzuron and fenitrothion against the eastern hemlock looper, *Lambdina fiscellaria fiscellaria*, in Newfoundland in 1986. Can. For. Serv., Newfoundland For. Centre, Info. Rep. N-X-263, 31 pp.

Robertson A. 1987. Using trees to study wind. Arboricultural Journal 11(2):127-143.

Robertson, A. 1987. The centroid of tree crowns as an indicator of abiotic processes in a balsam fir wave forest at Spirity Cove, Newfoundland. Can. J. For. Res. 17(7):746-755.

Sundaram, A., A. G. Raske, R. J. West and A. Retnakaran. 1988. Comparing atomization characteristics of some *Bacillus thuringiensis* and diflubenzuron formulations. Proc. Symp. on the aerial application of pesticides in forestry, G. W. Green (ed.) pp. 349-352. 20-22 October 1987, Ottawa. (Also a poster presented at the Symposium.)

Sundaram, A., A. G. Raske, R. J. West and A. Retnakaran. 1988. Spray atomization deposition patterns of one Newtonian and two pseudoplastic formulations after aerial application over a mature conifer forest in Newfoundland. J. Environ. Sci. Health, B23(1):85-99.

Sundaram, K. M. S., Sundaram, A., A. G. Raske, R. J. West and A. Retnakaran. 1988. Comparing atomization characteristics and foliage deposit of some Sumithion 20F and Matacil 180F formulations. Proc. Symp. on the aerial application of pesticides in forestry, G. W. Green (ed.) pp. 353-358. 20-22 October 1987, Ottawa. (Also a poster presented at the Symposium.)

Thompson, I. D. 1987. The myth of integrated forestry/wildlife management. Queen's Quarterly 94:609-621.

Thompson, I.D. and P. W. Colgan. 1987. Numerical responses of marten to a food shortage in northcentral Ontario. Jour. Wildl. Manage. 51:824-835.

West, R. J., J. C. Cunningham and W. J. Kaupp. 1987. Ground spray applications of Virtuss[R], a nuclear polyhedrosis virus, against white-marked tussock moth larvae at Bottom Brook, Newfoundland in 1986. Can. For. Serv., Newfoundland For. Centre, Info. Rep. N-X-257.

Miscelianeous Publications

Bowers, W. W. 1987. Ecology of *Polygraphus rufipennis* in Newfoundland. Presented at the Forest Insect Work Conference, Albany, N.Y., 11-12 March 1987 (Abstract Printed in Proceedings).

Bowers, W. W. and A. Retnakaran. 1987. The effectiveness of insect growth regulators against the balsam woolly aphid in Newfoundland in 1987. Report to the 15th Annual Forest Pest Control Forum, Ottawa, 17-19 November 1987.

Carew, G. C. 1987. Forest disease conditions. Report prepared for submission for the 28th Northeastern Forest Pathology Workshop, Fredericton, New Brunswick, Canada. 2-4 June 1987. 3 pp.

Cunningham, J. C., W. J. Kaupp and R. J. West. 1987. Research on insect viruses. 15th Annual Pest Control Forum, Ottawa, Nov. 1987.

Hudak, J. and A. G. Raske. 1988. Contribution towards 50-year Anniv. Publication of FIDS. Can. For. Serv., Ottawa, Ont.

Hudak, J., L. J. Clarke and G. C. Carew. 1987. Forest insect and disease conditions in Canada in 1986. Can. For Serv., NeFC contribution to the Annual Rep. For. Ins. Dis. Survey, Ottawa.

Hudak, J., G. R. Warren and G. C. Carew. 1987. The status of scleroderris canker in Newfoundland in 1987. Report prepared for the 15th annual Forest Pest Control Forum, Ottawa, 17-19 November 1987. Can. For. Serv., NeFC, St. John's, Newfoundland.

Mallik, A. U. and B. A. Roberts. 1987. Stand development of red pine in relation to wildfire in Newfoundland. Paper presented at the annual meeting of the Canadian Botanical Association, 14-18 June 1987. Abstract published. The Canadian Botanical Association bulletin 20: 20 p.

Meades, W. J. 1987. The integration of forest site classification and FORCYTE 10 calibration for balsam fir in western Newfoundland. Paper presented at the IEA-CPC 10 workshop. In predicting the consequences of intensive forest harvesting on long-term productivity using site classification. Charlstown, South Carolina, 5-10 October 1987.

Pardy, K. E. 1987. Biological survey of forest insects of Labrador. Paper presented to the Annual Meeting of the Acadian Ent. Soc., Charlottetown, PEI, 17-19 Aug. 1987. (Abstract printed in the Proceedings.)

Raske, A. G. 1987. Forest pest update: Important forest pests in Newfoundland in 1986. Paper presented at the Ann. Meeting, Acad. Ent. Soc., Charlottetown, PEI, August 1987. (Abstract printed in the Proceedings.)

Raske, A. G., R. J. West, J. Hudak and A. Retnakaran. 1987. The experimental spray program against the hemlock looper in Newfoundland in 1987. Rept. 15th Ann. For. Pest Control Forum, Ottawa, 17-19 November 1987.

Roberts, B.A. 1987. Merritt Lyndon Fernald (1873-1950); his investigations and discoveries in the Newfoundland flora. pp. 148-157. *In:* Avalon Chapter of Sigma Xi, St. John's, Nfld. ISBN No. 0-9693100-0-5.

Roberts, B.A. 1987. The importance of trees in the urban environment. Invited paper presented at the Canadian Parks and Recreation Association Conference '87. Tomorrow's Network Today, St. John's, Nfld., 10 August 1987.

Roberts, B. A. and A. U. Mallik. 1987. Responses of red pine to wildfire in Newfoundland. Paper presented at the annual meeting of the Canadian Botanical Association, 14-18 June 1987. Abstract published. The Canadian Botanical Association Bulletin 20: p. 20.

Robertson, A. 1987. Annual report: WG. 'Foresters and the media'. International Union of Societies of Foresters. Ottawa, Canada.

Stone, Cynthia. 1988. Providing for the future. 7 pp. Canada-Newfoundland Forest Resource Development Agreement publication.

Trelawny, P. M. 1987. Some possible effects of recent advances in biotechnology on the Canadian dairy industry. Seminar presented at the Department of Rural Economy, University of Alberta. 23 September 1987.

Trelawny, P., *et al.* 1988. Final evaluation of FSA II, 1980/81 to 1985/86. Report of the FSA II Evaluation Committee. 120 p.

Veitch, G. K. 1988. Monitoring review of 1987 Crown silviculture projects.

Veitch, G. K. 1988. Canada-Newfoundland Forest Resource Development Agreement Procedures Manual.

Warren, G. R. 1988. The identities, roles and interactions of the fungi associated with stem biodeterioration of balsam fir stressed and killed by the spruce budworm in Newfoundland. Abstract PhD thesis research, SUNY-CESF for Northeast Forest Insect Work Conference, Albany, NY, 2-3 March 1988.

West, R. J. 1987. Cone and seed pest update, Newfoundland Forestry Centre, CFS. Canadian Tree Improvement Association News Bulletin (Tree Seed Working Group) 8:4-5.

West, R. J. 1987. Stem implants of acephate on cone insects of black spruce. 15th Annual Pest Control Forum, Ottawa, Nov. 1987.

West, R. J. 1987. The 1987 experimental spray program against the hemlock looper. Can. For. Serv., Newfoundland For. Centre, video tape, 23 min.

Newsletter Articles

Alexander, W. L. 1987. Newfoundland foresters visit to Sweden. Can. For. Serv., NeFC. Woody Points 16(4):1-2.

Bowers, W. W. 1987. Communication among Newfoundland insects: challenges and opportunities. Can. For. Serv., NeFC. Woody Points.

Carew, G. C. 1988. A new leaf spot disease of hawthorn in Newfoundland. Can. For. Serv., NeFC. Woody Points 17(1):4-5.

Clarke, L. J. and G. C. Carew. 1987. Forecast of forest insect and disease conditions in Newfoundland and Labrador in 1987. Can. For. Serv., NeFC. Woody Points 16(2):1-3.

Clarke, L. J. and G. C. Carew. 1987. Forest insect and disease conditions in Newfoundland and Labrador in 1987. Mid-season report. Can. For. Serv., NeFC. Woody Points 16(3):1-3.

Clarke, L. J. and G. C. Carew. 1987. Forest insect and disease conditions in Newfoundland and Labrador in 1987. Can. For. Serv., NeFC. Woody Points 17(1):5-8.

Clarke, L. J. and G. C. Carew. 1988. Forest insect and disease conditions in Newfoundland and Labrador in 1987. Can. For. Serv., NeFC. Woody Points 17(1):5-8.

Hudak, J., A. G. Raske and R. J. West. 1987. Some questions and answers about the hemlock looper outbreak and its control. Can. For. Serv., NeFC. Woody Points 16(2):5-11.

Mallik, A. U. and P. F. Newton. 1987. Auto inhibition of black spruce. Can. For. Serv., NeFC. Woody Points 15(1):6.

Meades, W. J. 1987. NeFC hosts FORCYTE 11 workshop. Can. For. Serv., NeFC. Woody Points 17(1):2-3.

Newton, P. F. 1987. Forest growth and yield modelling at NeFC. Can. For. Serv., NeFC. Woody Points 16(4):8.

Raske, A. G. 1987. Budworm research update. Can. For. Serv., NeFC. Woody Points 16(1):7.

Raske, A. G. and R. J. West. 1987. Hemlock looper spray program. Can. For. Serv., NeFC. Woody Points 16(2):4.

Robertson, A. W. 1987. Wave forests: A rare phenomenon. Can. For. Serv., NeFC. Woody Points 16(3):7-8.

Titus, B. D. 1987. Optimal planting position on TTS microsites: survival of Jack pine and Japanese larch after one growing season. Can. For. Serv., NeFC. Woody Points 16(3):4.

Titus, B. D. 1987. Forestry in Northern Finland. Can. For Serv., NeFC. Woody Points 16(4):2-4.

West, L.R. 1987. Eastern Canada Precommercial Thinning Working Group Visits Western Newfoundland. Can. For. Serv., NeFC. Woody Points 16(4):6-7.

West, R. J. 1987. Black army cutworms invade new plantations. Can. For. Serv., NeFC. Woody Points 16(3):6.

West, R. J. 1987. Aerial spray of virus at Bottom Brook. Can. For. Serv., NeFC. Woody Points 16(3):6.